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Update on the γ +jet and Z+jet calibration.

- background at low luminosity (γ +jet)
- calibration at low luminosity
- calibration coefficients for quark and gluon jets
- Z+jet calibration errors

1. BACKGROUND AT LOW LUMINOSITY

$$L = 2 \times 10^{33} \text{cm}^{-2}\text{s}^{-1}$$

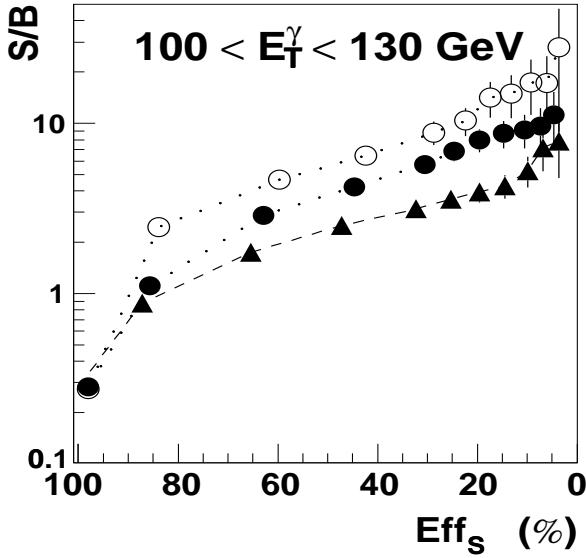
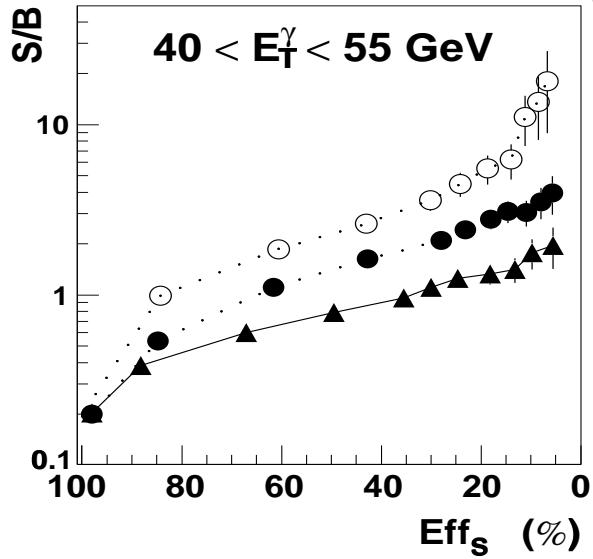
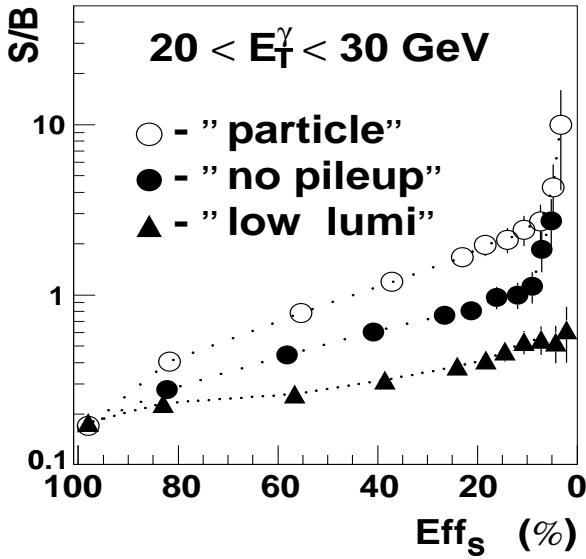
For background suppression we put constraints (selection cuts) on the values:

\mathbf{E}_T^{jet2} is E_T of the second leading jet;

$\Delta\phi$ is angle between " γ " and jet;

\mathbf{E}_T^{out} is vector sum of E_T in the area outside a cone of the size of 7x7 crystals around " γ " and outside of cone R=0.8 around of jet;

$\mathbf{E}_{T\gamma}^{isol}$ is summarized E_T in cone R=0.5 outside a cone of the size of 7x7 crystals around " γ " with E cuts on cell energy is 3σ E noise.



Cuts for $\text{Eff}_s = 50\%:$

$E_T^\gamma \text{ (GeV)}$	20-30	40-55	100-130
$E_{T \text{ max}}^{\text{jet}2} \text{ (GeV)}$	16	22	33
$\Delta\phi_{\min}$	1.9	2.7	2.8
$E_{T \text{ max}}^{\text{out}} \text{ (GeV)}$	29	32	35
$E_{T \text{ max}}^{\text{isol}} \text{ (GeV)}$	2.7	3.9	3.9

Ratio Signal/Background v.s. Eff_S .

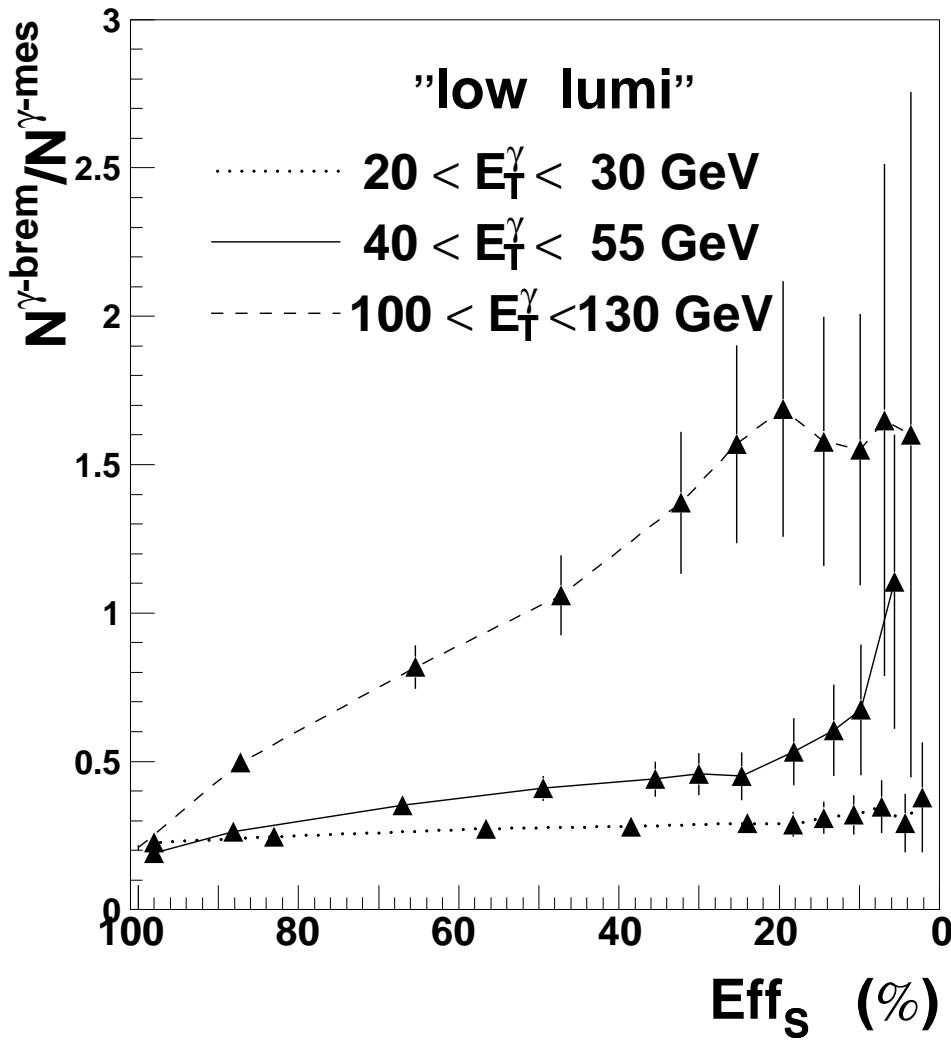
S/B ratio is worse at low luminosity than the S/B ratio at "particle"-level and also without pileup. We have at

$\text{Eff}_S > 10\%:$

$\text{S/B} < 0.7 \text{ at } E_T^\gamma \approx 20 \text{ GeV},$

$\text{S/B} < 2 \text{ at } E_T^\gamma \approx 40 \text{ GeV},$

$\text{S/B} < 8 \text{ at } E_T^\gamma \approx 100 \text{ GeV}.$

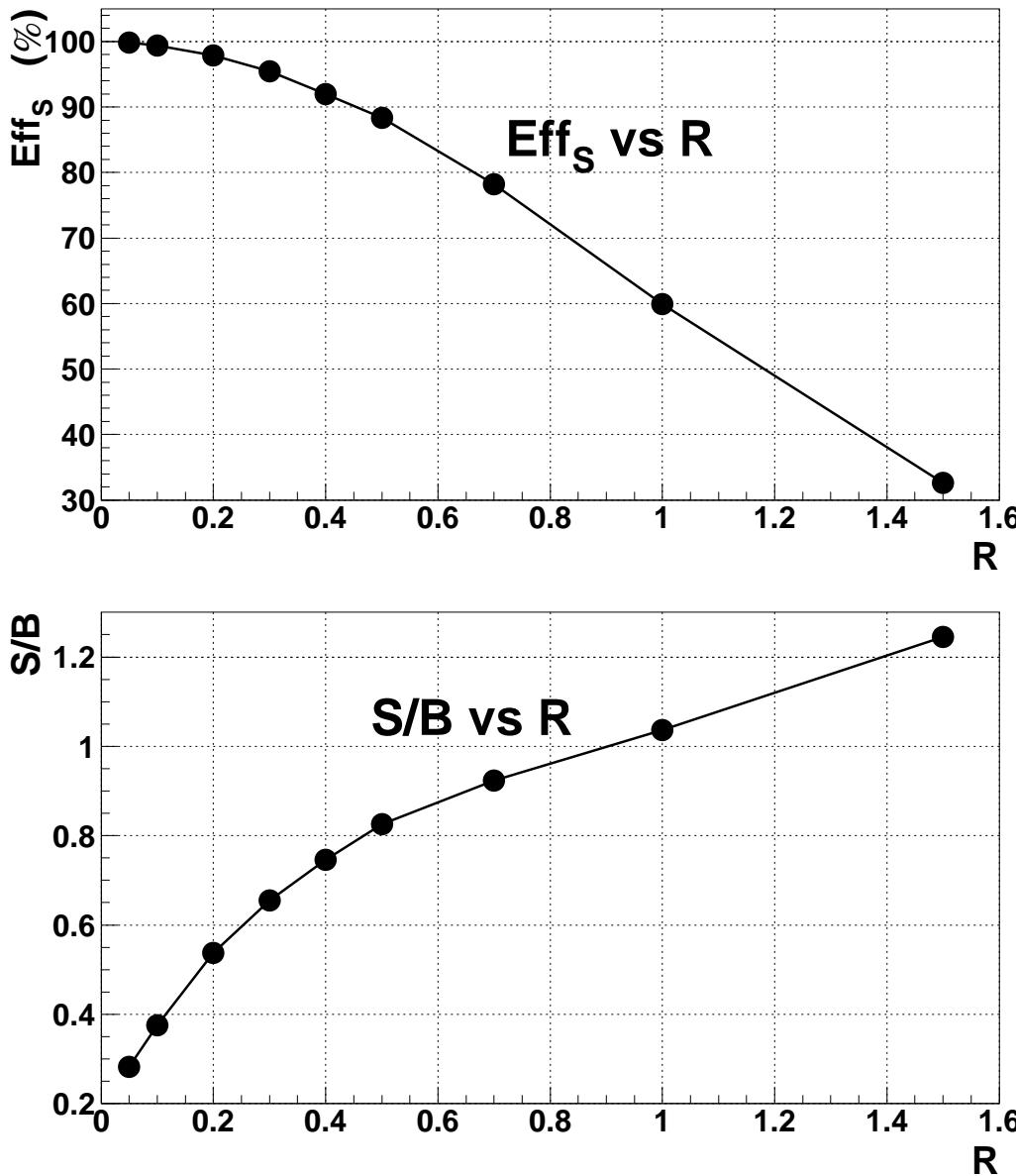


Background contents.

Ratio γ -bremstrahlung/ γ -mesons decays v.s. Eff_S .

Part of γ -brem is large. Thus a possibility of background suppression by the way of the mesons rejection is small.

Case $40 < Et^\gamma < 100 \text{ GeV}$.



Eff_S and S/B v.s. R with cut:

no charged tracks with $P_T > 1 \text{ GeV}$ in cone \mathbf{R} around " γ ".

(Preliminary results at particle-level).

We have for $R = 0.5 \div 1.5$: Eff_S = 90 \div 30%; S/B = 0.8 \div 1.2. Thus a possibility of background suppression with isolation cuts in tracker is small.

2. CALIBRATION AT HIGH BACKGROUND.

By the way of the event selection with

- calorimeter cuts,
- tracker isolation,
- mesons rejection

we predict for low luminosity

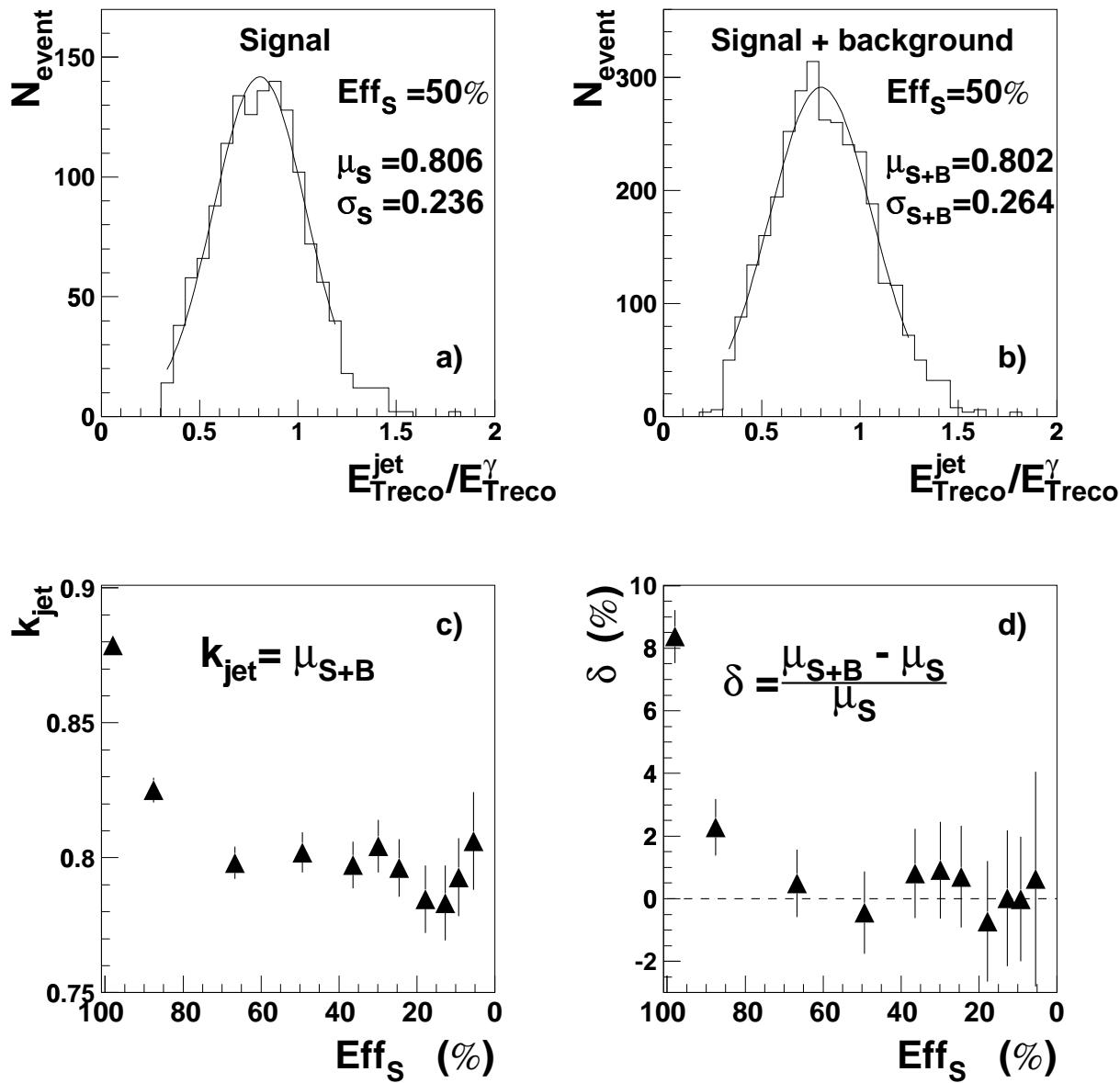
$$S/B \approx 1 \div 10 \text{ for } E_T^\gamma = 20 \div 100 \text{ GeV}$$

\Rightarrow we investigate a possibility to use the background for the in situ calibration.

We compared calibration koefficient $k_{jet} = \mu$.

μ **is the peak of $\frac{E_{T^{reco}}^{jet}}{E_T^\gamma}$ distribution.**

Case $40 < Et^\gamma < 55 \text{ GeV}$.

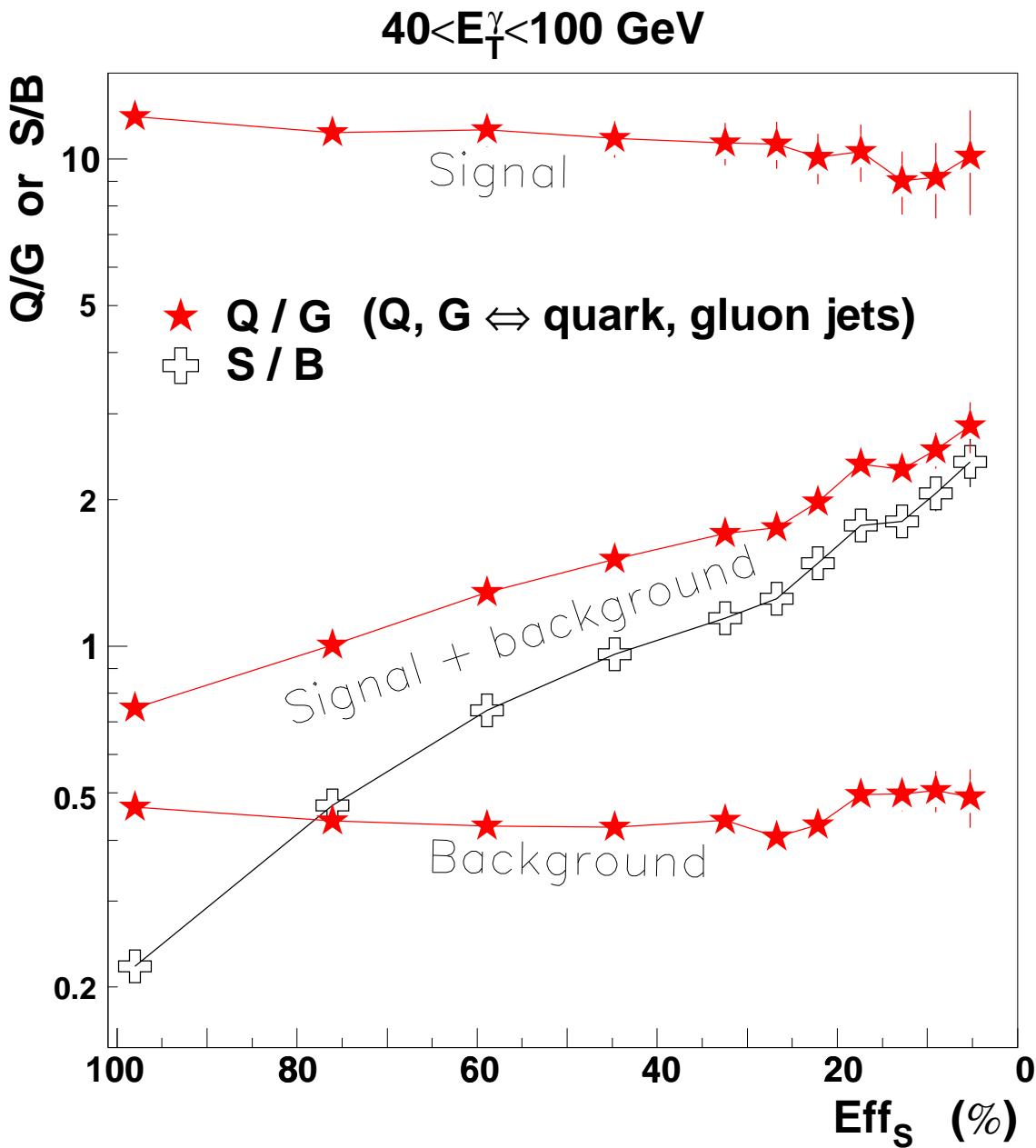


$E_{\text{Treco}}^{\text{jet}}/E_{\text{Treco}}^{\gamma}$ distribution in cases signal and signal+background

(a-b). Calibration koefficient k_{jet} and difference of k_{jet} in cases signal and signal+background v.s. Eff_S (c-d).

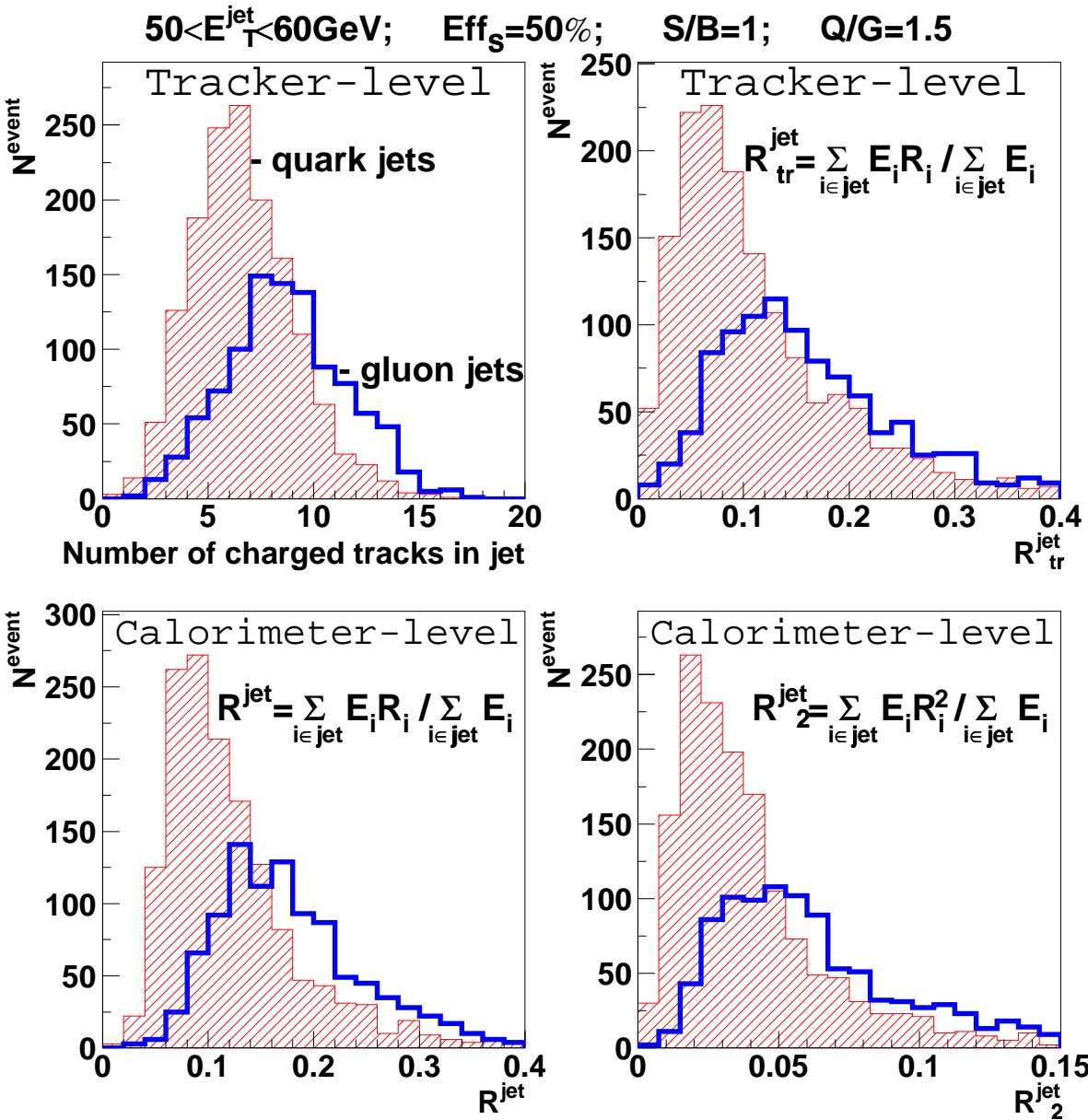
Preliminary results show: background does not destroy the calibration ($\delta < 1\%$) for event selection with S/B > 0.5 (Eff_S < 70% for $Et^\gamma \approx 40 \text{ GeV}$).

3. CALIBRATION COEFFICIENTS FOR QUARK AND GLUON JETS



Q/G = (events with quark jets)/(events with gluon jets)
in cases signal ($Q/G \approx 10$), background ($Q/G \approx 0.5$) and
signal+background and S/B ratio v.s. Eff_S.

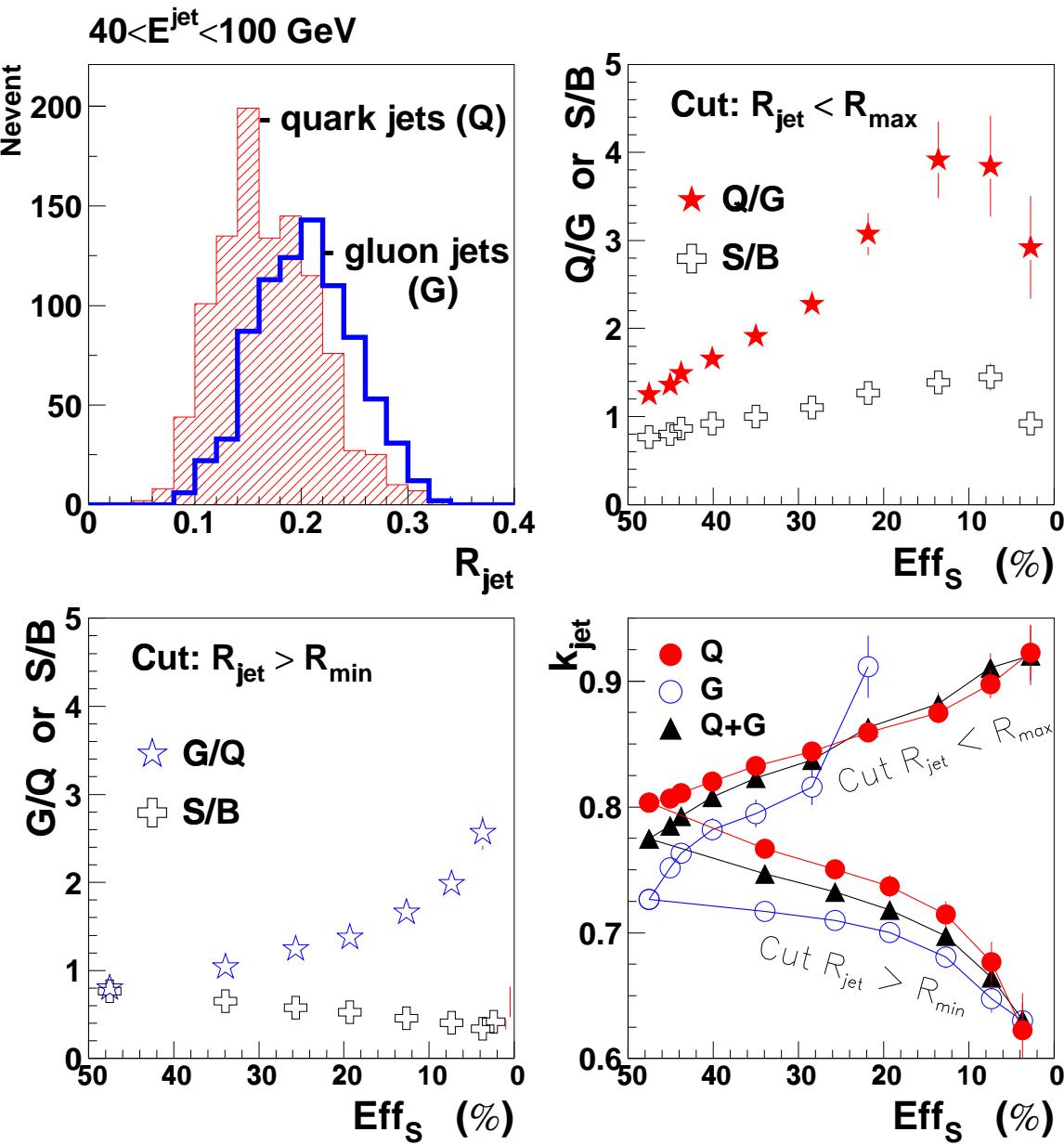
Q/G ratio in case of signal+background depends from
S/B ratio.



Distributions for ideal tracker and calorimeter (PYTHIA-simulation) for quark and gluon jets:

- number of charged tracks in jet,
- weighted radius of jet at tracker-level ($R_{\text{tr}}^{\text{jet}}$),
- weighted radius of jet at calorimeter-level (R_{jet}),
- squared weighted radius of jet at calorimeter-level (R_2^{jet}).

We can see that the quark and gluon jets separation is not good.



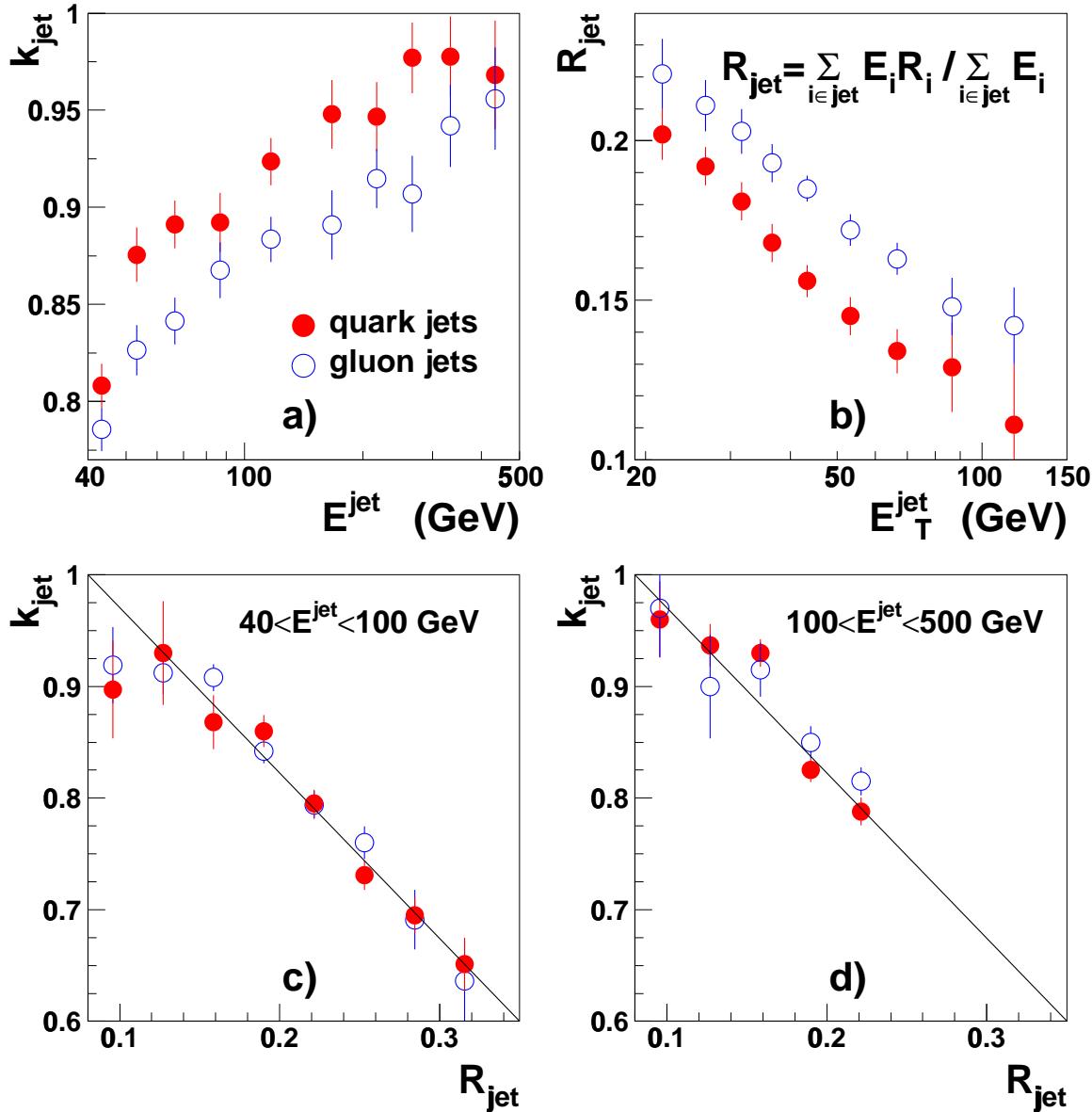
- R^{jet} distribution (weighted radius of jet at low luminosity) for quark and gluon jets ($\text{Eff}_S = 50\%$).
- Q/G , G/Q , S/B and k_{jet} v.s. Eff_S for different cuts on R^{jet} .

We have for $\text{Eff}_S > 5\%$ with cuts on R^{jet} :

$$Q/G \approx 4, \quad k_{jet} \approx k_{jet}^Q \quad (\text{cut: } R^{jet} < R_{\max});$$

$$G/Q \approx 2.5, \quad k_{jet} \approx k_{jet}^G \quad (\text{cut: } R^{jet} > R_{\min}).$$

k_{jet} is shifted under influence R^{jet} cuts.



Calibration coefficient for quark and gluon jet v.s. E^{jet} (a); weighted radius of jet v.s. E_T^{jet} (b); calibration coefficient for quark and gluon jet v.s. R_{jet} for different E_T^γ (c-d).

Preliminary: k_{jet} is same function of R_{jet} for quark and gluon jet and for different E^{jet} (c-d).

4. Z+JET CALIBRATION

Z+jet events from Spring01 production have been used:

PYTHIA6.152 process selection.

MSUB 15=1 (ff~-> g + gamma* / Z0)

MSUB 30=1 (fg -> f + gamma* / Z0)

CKIN 3=10 (min. pt hard)

Preliminary selection of $Z(\rightarrow \mu^+\mu^-)$ +jet events at PYTHIA level:

$$p_t^{jet,Z} > 20 GeV/c,$$

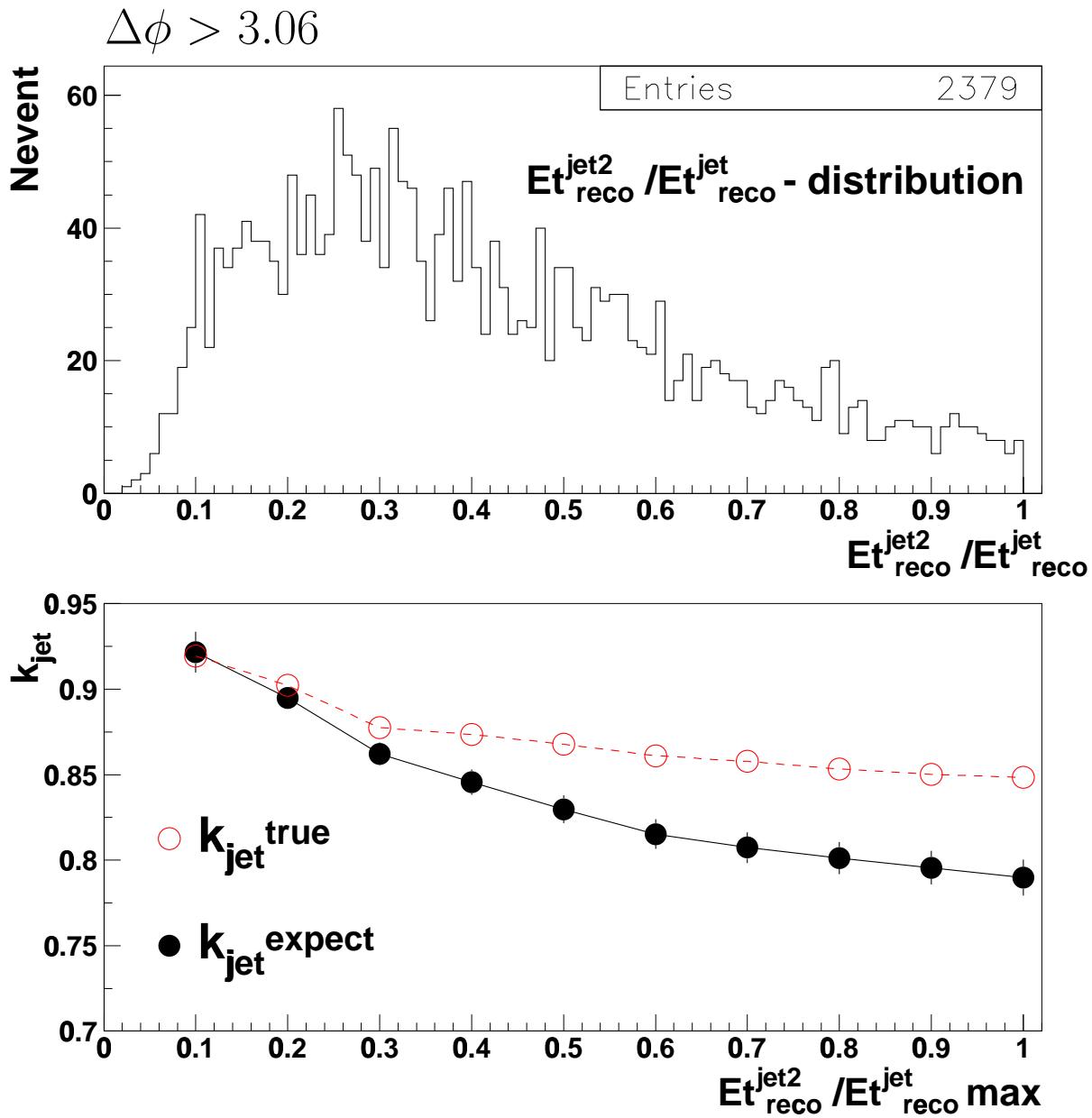
$$p_t^\mu > 3.5 GeV/c,$$

$$|\eta^\mu| < 2.4,$$

$$|\eta^{jet}| < 5,$$

$$90 < M_{inv}^{\mu^+\mu^-} < 92 GeV/c^2.$$

No. of events is 10000.



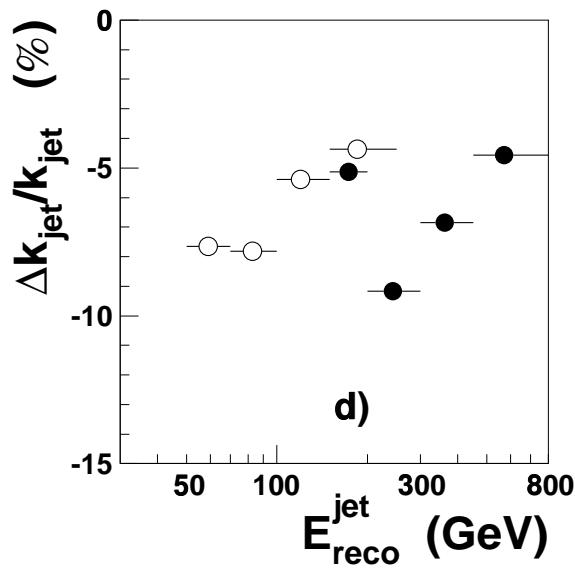
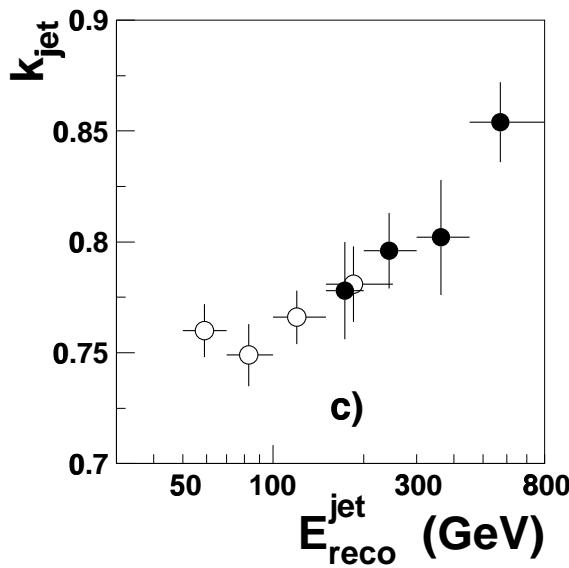
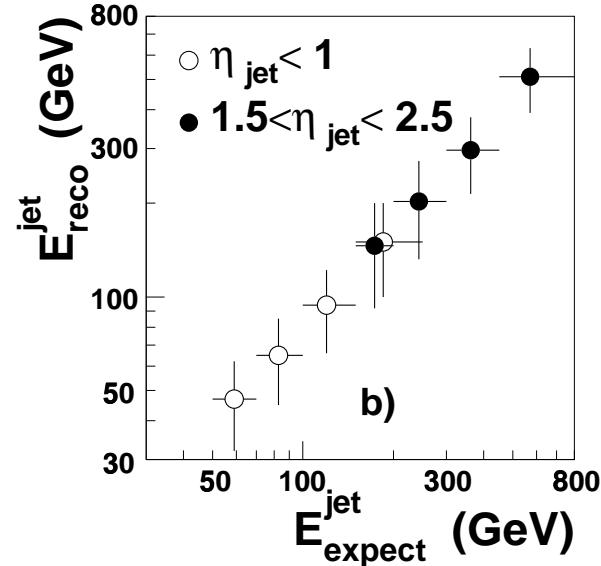
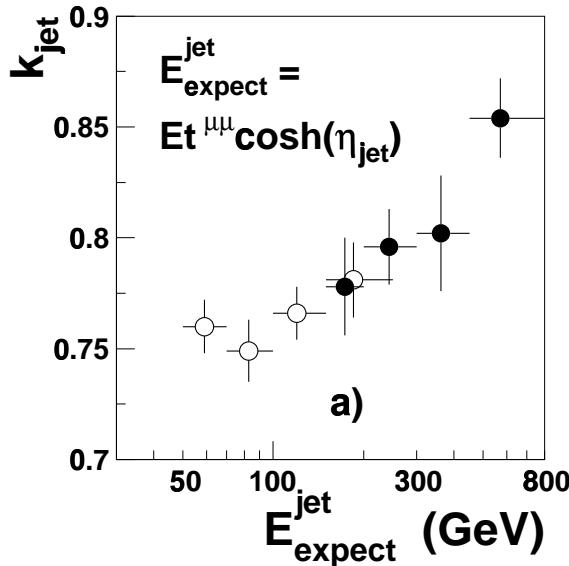
$Et_{reco}^{jet2}/Et_{reco}^{jet}$ distribution and calibration coefficient vs Et^{jet2} cuts at $\Delta\phi > 3.06$.

We have at soft Et^{jet2} cuts $\Delta k_{jet} \approx -7\%$.

Condition for calibration ($\Delta k_{jet} \approx 1\%$) are happen at cut

$$Et_{reco}^{jet2}/Et_{reco}^{jet} < 0.3 \text{ (Eff}_S < 10\%\text{)}$$

$\text{Eff}_S = 70\%$, $\Delta\phi > 2.6$, $E_t^{\text{jet}2}/E_t^{\text{jet}} < 0.8$

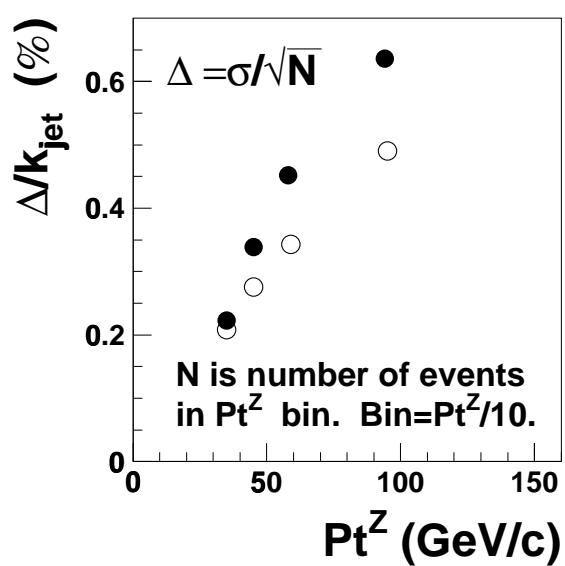
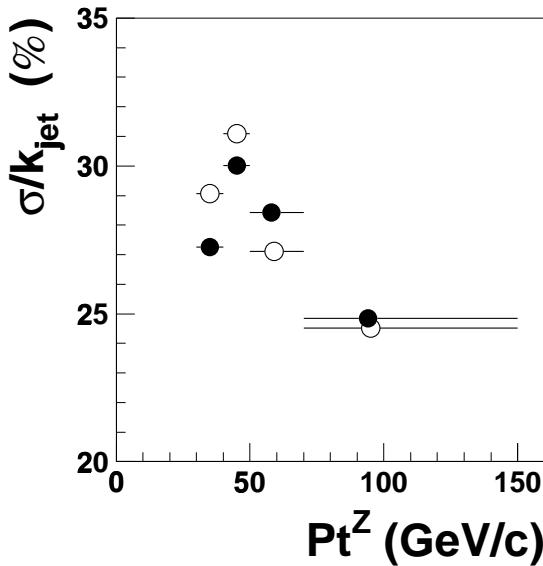
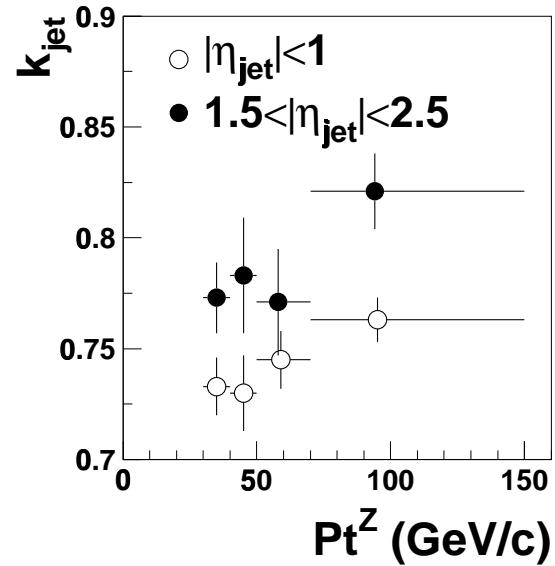
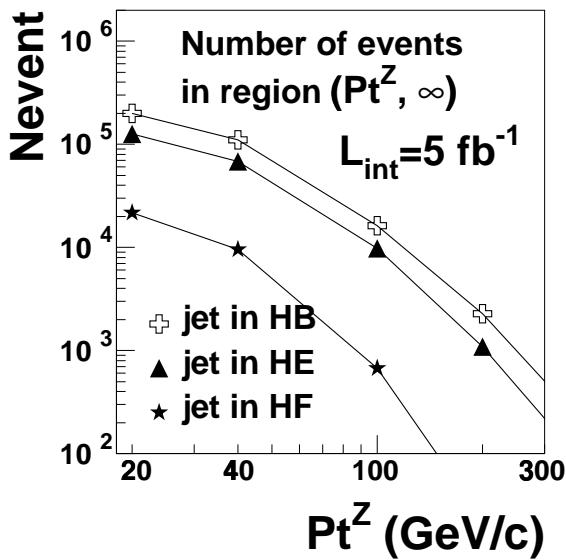


Values of k_{jet} and Δk_{jet} vs $E_{\text{jet}}^{\text{reco}}$ for different η_{jet} .

Plot (c) was obtained with usage of values k_{jet} (a) and $E_{\text{jet}}^{\text{reco}}$ (b) in $E_{\text{jet}}^{\text{expect}}$ bins.

We have at soft cut for $E_{\text{jet}}^{\text{reco}}=50 \div 700 \text{ GeV}$

systematic errors $\Delta k_{\text{jet}} \approx -10 \div -5\%$



Total number events (Nevent) per 3 month at low luminosity (no cut) and errors of calibration at soft selected cut: $Et_{reco}^{jet2}/Et_{reco}^{jet} < 0.8, \Delta\phi > 2.6$.

We have for $E\gamma=20 \div 100 \text{ GeV}$:

Number events is $\approx 10^5 \div 10^4$,

Peak μ error is $\Delta \approx 0.2 \div 0.5\% k_{jet}$.

Conclusions

- A possibility of background suppression at low luminosity by means of the event selection works worsely with low luminosity pileup than "particle" and "no pileup" levels:
 $S/B \approx 0.7 \div 8$ for $E_T^\gamma = 20 \div 100 \text{ GeV}$
 $(\text{Eff}_S = 10\%)$.
- However background does not destroy the calibration for event selection with $S/B \geq 0.5$.
- Calibration coefficient for quark and gluon is same function of weighted radius of jet.
- We have in 3 month at low luminosity errors of calibration coefficient $\Delta < 1\%$ in bin= $E_T^\gamma/10$ at $E_T^{jet} < 100 \text{ GeV}$ (Z+jet calibration).